

# Chip-Implant-Contact Lenses a Device for Drug Delivery: A Reality

**Ankita Desai\***

Maliba Pharmacy College, Uka Tarsadia University, Bardoli, Surat  
Email: ankitadesai4193@gmail.com

**G**laucoma, a second major cause of blindness, is an eye disorder caused by an increase in the Intraocular pressure (IOP) that leads to damage of the optic nerve and, ultimately, blindness. The disease affects more than 6.5 crore people, leaving around 85 lakhs with blindness. For its treatment, majority of the dosage available in the market is in the form of eyedrop solutions. Eye drops are easily washed off either by tear drainage or by blinking when instilled in the eye; this decreases their presence on to the site of action leaving only 1–5% drugs. To overcome this issue, eye drops are generally prescribed with a high dosing frequency; this encourages the drug-associated side effects and also reduces patient acceptance. Therefore, an innovative approach was required to treat long-standing eye diseases such as glaucoma, by improving the drug residence time on the eye surface.

Our team at Maliba Pharmacy College, which is a constituent college of Uka Tarsadia University, Surat, is working to develop an innovative method to bypass all the issues associated with eye drops and other currently utilised methods giving a more comfortable medical device to the patients suffering from eye disorder like glaucoma.

For the last five years, we have been trying to understand the issues faced by the patients with eye diseases. This has led us to experiment with different established techniques to address the problem. From in-situ gels, that is originally in the form of eye-drops solution, but when instilled in the eyes' changes to gel form and then the drug is released. It has given success at the laboratory scale, unfortunately during animal studies it failed to deliver for a long time and our target remained unmet. Results were scary as hard work of several months went in vain.

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\* Ms. Ankita Desai, Ph.D. Scholar from Maliba Pharmacy College, Surat, is pursuing her research on “formulation and Evaluation of Therapeutic Contact Lenses for Ophthalmic Drug Delivery.” Her popular science story entitled “Chip-Implant-Contact Lens as a Device for Drug Delivery: A Reality” has been selected for AWSAR Award.

The turning point for my team was an idea of delivering drug through contact lenses surfaced in our laboratory and we started searching available data and methods. We have found several loopholes in the current available data and decided to diverge the energy to solve the problem. The available, widely used, method includes soaking the contact lenses in the drug solution and then delivering it to the patients, but that did not yield any commendable results. In another method of preparation, where the drug is mixed with the contact lens material and then the contact lenses are fabricated, even that did not reach the destination as it barred (A: Is this blurred?) vision due to the presence of drug in the entire region of the contact lens.

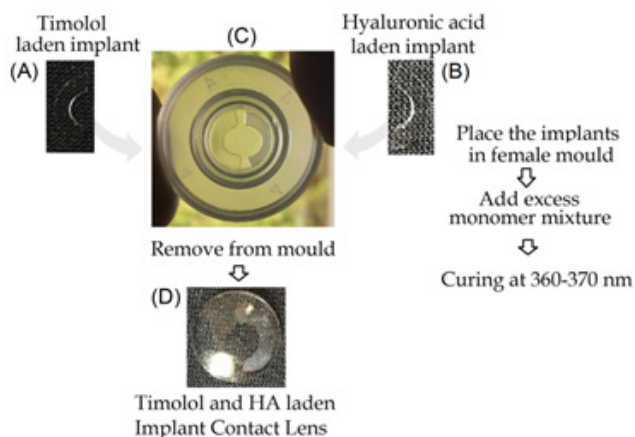
Then, we have come up with an idea of fabricating a chip-implanted contact lens. We have formulated a chip made up of contact lens material and drugs loaded into it. This drug-chip was then stabilised inside the contact lens. The chip resembled a complete ring cut into two halves, each containing two different molecules for increasing its effect. This chip/ring was placed such that they left 6 mm from the centre of the contact lens, so that they do not place any difficulty in vision. Initial results were encouraging and demanded more time to be hundred percent perfect.

We did not want to take chances and did every study possible to find out the loopholes of our proposed method. It brought several challenges and gave rise to many new problems. Some of them are the drug loss during extraction, wet sterilisation and storage in the final packaging solution. Each of them were addressed separately and successfully. Drug loss during the extraction was overcome by placing the drug inside water, which was utilised to remove the excess unreacted contact lens material that remained on the surface after fabrication. This has saved approximately 10% of the total drug loaded in the contact lenses.

Another issue was drug loss during wet sterilization (heating with water in a cooker like system for 30 minutes) of the contact lenses. This method involves exposure of the material to such an environment that no microbes remain in it, however, the presence of water leads to drug loss in sterilisation solution. To overcome this, dry radiation sterilisation technique was used which does not involve water and thus bypassed drug loss due to water presence. Both these changes prevent 40% drug loss from the contact lenses.

Laboratory study of the drug-chips implanted contact lenses showed drug release upto 7 days that means, a single contact lens can free the patient for 7 days from the eye-drop therapy. Utilising the instruments at Shah-Schulman Center for Surface Science and Nanotechnology, Dharmsinh Desai University (Nadiad, Gujarat), the surface structure of the contact lenses was found to be 400 times smoother and elegant than those available in the market. The product is being developed as a platform, so that very conveniently the drugs can be changed according to the need of the disease or disorder. We have kept hyaluronic acid fixed in one ring/chip as it gives the comfort to the contact lens wearer for more than a week.

Initially, we got success with timolol, which is gold standard for the treatment of glaucoma. Animal studies has shown the effect of contact lenses and glaucoma was treated in the initial batches. Further studies are being carried out to make the product reach clinical trials and the team is expecting the final product to launch in the market by 2024.



Dr Maulvi's lab (A: Please give context) is engaged in constant development of new technologies utilising contact lenses for the delivery of drugs to various parts of the eye. It is the motto of the principal investigator and team to eradicate preventable.